



US007866638B2

(12) **United States Patent**
Neumann et al.

(10) **Patent No.:** **US 7,866,638 B2**
(45) **Date of Patent:** **Jan. 11, 2011**

(54) **GAS LIQUID CONTACTOR AND EFFLUENT
CLEANING SYSTEM AND METHOD**

(75) Inventors: **David Kurt Neumann**, Colorado
Springs, CO (US); **Nicholas J. Miller**,
Colorado Springs, CO (US); **Boris R.**
Nizamov, Colorado Springs, CO (US);
Thomas Lee Henshaw, Monument, CO
(US); **Andrew R. Awtry**, Colorado
Springs, CO (US); **Jason K. Brasseur**,
Colorado Springs, CO (US); **Keith R.**
Hobbs, Colorado Springs, CO (US);
Jason A. Tobias, Colorado Springs, CO
(US); **William E. McDermott**, Littleton,
CO (US)

(73) Assignee: **Neumann Systems Group, Inc.**,
Colorado Springs, CO (US)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 0 days.

(21) Appl. No.: **12/459,685**

(22) Filed: **Jul. 6, 2009**

(65) **Prior Publication Data**

US 2010/0011956 A1 Jan. 21, 2010

Related U.S. Application Data

(63) Continuation-in-part of application No. 12/012,568,
filed on Feb. 4, 2008, which is a continuation of appli-
cation No. 11/057,539, filed on Feb. 14, 2005, now Pat.
No. 7,379,487.

(60) Provisional application No. 61/100,564, filed on Sep.
26, 2008, provisional application No. 61/100,606,
filed on Sep. 26, 2008, provisional application No.
61/100,591, filed on Sep. 26, 2008.

(51) **Int. Cl.**
B01F 3/04 (2006.01)

(52) **U.S. Cl.** **261/115**; 96/236; 96/239;
239/594; 261/116; 261/118

(58) **Field of Classification Search** 96/236,
96/239, 356, 358; 261/115–118; 239/592,
239/594, 595, 597–599
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2,484,277 A * 10/1949 Fisher 96/262

(Continued)

FOREIGN PATENT DOCUMENTS

GB 2059286 A * 4/1981 261/118

OTHER PUBLICATIONS

Huijgen, et al., "Cost Evaluation of CO₂ sequestration by aqueous
mineral carbonation," Energy Conversion and Management, 48, pp.
1923-1035, 2007.

(Continued)

Primary Examiner—Richard L Chiesa

(74) *Attorney, Agent, or Firm*—Scott J. Hawranek; Hogan
Lovells US LLP

(57) **ABSTRACT**

The invention relates to a gas liquid contactor and effluent
cleaning system and method and more particularly to an array
of nozzles configured to produce uniformly spaced flat liquid
jets shaped to minimize disruption from a gas. An embodi-
ment of the invention is directed towards a gas liquid contac-
tor module including a liquid inlet and outlet and a gas inlet
and outlet. An array of nozzles is in communication with the
liquid inlet and the gas inlet. The array of nozzles is config-
ured to produce uniformly spaced flat liquid jets shaped to
minimize disruption from a gas flow and maximize gas flow
and liquid flow interactions while rapidly replenishing the
liquid.

20 Claims, 23 Drawing Sheets

